May 1993

COLUMBIA RIVER COORDINATED INFORMATION SYSTEM

PHASE II PROJECT SUMMARY REPORT 1992

DOE/BP-94402-6

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views of this report are the author's and do r necessarily represent the views of BPA.

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PHASE II PROJECT SUMMARY REPORT 1992

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PREFACE

An essential component of the effort to rebuild the Columbia Basin's anadromous fish resources is that available information and experience be organized and shared among numerous organizations and individuals. Past experience and knowledge must form the basis for actions into the future. Much of this knowledge exists only in unpublished form in agency and individual files. Even that information which is published in the form of technical and contract reports receives only limited distribution and is often out of print and unavailable after a few years. Only a small fraction of the basin's collective knowledge is captured in permanent and readily available databases (such as the Northwest Environmental Database) or in recognized journals.

State, tribal, and federal fishery managers have recognized these information management problems and have committed to a program, the Coordinated Information System Project, to capture and share more easily the core data and other information upon which management decisions are based. That project has completed scoping and identification of key information needs and development of a project plan. Work performed under the CIS project will be coordinated with and extend information contained in the Northwest Environmental Database. Construction of prototype systems will begin in Phase 3.

This report is one in a series of seven describing the results of the Coordinated Information System scoping and needs identification phase. A brief description of each of these reports follows.

CIS Phase II Products

Phase II Summary Report

This report (Roger 1992) summarizes and integrates the results of the next five reports and relates them to deliverables identified in the Phase II cooperative agreement. Broader issues of organization and operation which are not appropriate for the more focused reports are also discussed. This report should be viewed as an executive summary for the CIS project to date. If one wants a quick overview of the CIS project, this report and the project plan will provide that perspective.

Report on Information Needs

This report (Weber, et al. 1992) identifies the core information needed to plan, implement, monitor, and evaluate projects to manage and restore anadromous fish. This information has been organized into various categories and missing items are identified. Prototype testing in Phase 3 will focus on this core information.

Data Catalog Report

This report (O'Connor, et al. 1992) might be thought of as a "yellow pages" directory describing relevant numeric data available throughout the basin. An easily searched electronic version will be developed during prototype development and the catalog will be maintained and expanded.

Technical and Administrative Options Report

This report (Allen, et al. 1992) describes a process for implementing the CIS and feasible hardware, software, and operational options. Recommendations are made for the prototype and implementation phases of the project.

Library Resource Options Report

This report (Roseberry 1992) describes options for the size and operational features for the non-numeric portion of the CIS. Recommendations are made for the prototype and implementation phases.

Stock Summary Reports

These reports (Olsen, et al. 1992; Hymer, et al. 1992; Kiefer, et al. 1992) are available in separate volumes for Oregon, Washington, and Idaho. The reports contain basic biologic information on anadromous fish populations in the Columbia Basin. This information will be incorporated into computerized data bases during prototyping and implementation and will be updated annually.

Project Plan

The Project Plan (Roger, et al. 1992) is derived directly from recommendations from the above reports. It describes anticipated activities, staff needs, and cost of the project for the testing and implementation phases.

EXECUTIVE SUMMARY

The goal of the CIS is to develop an efficient system for obtaining and exchanging information needed for planning, monitoring, and evaluating anadromous fish protection, mitigation, and enhancement activities in the Columbia River Basin.

Anadromous salmon in the Columbia River Basin are presently far below historic level of production, due to the impacts of development in the basin. To halt the downward trend in production and ultimately increase returns, the Northwest Power Planning Council developed the Columbia River Basin Fish and Wildlife Program. The Program outlines a coordinated plan for restoring anadromous salmonid runs to the basin. The goals and objectives outlined in the Program require addressing a complex set of problems that encompass a broad range of social, political, economic and biological issues. Resolution of these problems will require the efforts of a number of federal, state, and tribal agencies that have regulatory authority over activities that either directly or indirectly affect anadromous salmonids in the basin. Resource managers have realized the need for coordination in these efforts. The Coordinated Information System is designed to share information critical to Program development and evaluation efficiently among the numerous participants in the restoration process.

The CIS project is entering Phase 3 of the scheduled development process, in which prototypes of the system will be developed, tested, corrected, redefined, and linked into an operating system. Routine maintenance, updating, and enhancement will begin in Phase 4.

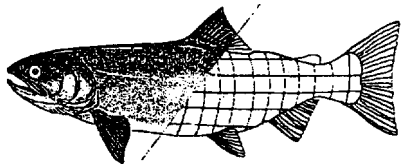
The proposed system will consist of several modules which are interconnected and accessed through a shared user interface. These modules will be organized into an Anadromous Fish Information System (AFIS), containing numeric information about basin populations, and an Anadromous Fish Reference System (AFRS), containing documentation for elements of the AFIS. The AFIS and AFRS together will meet identified critical information needs of users in an effective manner.

An iterative programming approach will be used to develop the system in discrete, but interconnected, modules. This approach differs from the classic software development process by focusing on coding small pieces of the system for user review and suggested modification, rather than completely designing all aspects of the system before coding begins. Prototyping is iterative and can lead to unexpected improvements to original designs because of the close coordination with user needs. Prototyping is frequently cheaper than classic approaches. Changes are made early in the process before larger investments in time and

code development are made.

The CIS project is estimated to cost between $1 .0 million and $1.3 million per year for the next three years. This will take the project through full development and one year of routine maintenance. Maintenance and upgrading costs beyond the third year will depend to a degree on the demand for additional services and features, but should be near the one million dollar level.

The fully operational CIS should easily repay these costs annually in increased efficiency and performance of activities conducted under the Fish and Wildlife Program and greater program accountability. These savings will come, for example, from reduction of duplicative data gathering efforts, earlier identification of the most effective recovery actions; more effective planning, and improved coordination of projects and data gathering activities.



INTRODUCTION

The Problem

The present system of gathering, interpreting, and sharing fishery resource information in the Columbia Basin was largely developed to meet the needs of management entities over the last five to ten years. Agencies, and even major divisions within agencies, have typically operated largely independently of one another. Certainly coordination and cooperation occurred, but it was typically on specific issues and primarily for short periods during the year. For instance, hatchery releases were coordinated between agencies and with hydropower system operators to improve passage conditions for juvenile seaward migrants. Managers also coordinated harvest regulations, especially in the mainstem Columbia River, during the summer and fall.

Issues and problems remained fairly stable and predictable until recent years. Predictability was enforced by the events of the salmon's life cycle. Every year fish were released from hatcheries, every year hydropower operations were of concern to protect migrating fish, every year fishing regulations had to be set. While the total complexity of issues affecting perpetuation of the resource was recognized, mechanisms existed for managers to address only a portion of these issues. The signing of the Pacific Salmon Treaty in 1985 created the first system of interlocking ocean harvest regulations and a formal mechanism for tracking the impacts of those regulations. The adoption, under U.S. v Oregon, of the Columbia River Management Plan created a formal linkage between operation of hatcheries and harvest controls. Federal hydropower licensing negotiations consider the effects of single dams on fishery resources.

While the totality of human impacts on fishery resources has long been recognized, the ability to deal with many problems directly has often been lacking. Fishery managers have not been able to control agricultural, domestic, or industrial development of watersheds or use of river water. Neither the tools nor the forums existed to discuss, evaluate, and regulate the cumulative impacts of multiple uses of watersheds on salmon production. As long as crises did not occur, management proceeded according to reasonably predictable schedules involving reasonably predictable issues.

Existing information management and sharing systems meet these needs fairly well. Agencies manage hatchery data, for instance, to be fiscally accountable to the funding source and meet specified juvenile production goals. Harvest success is often evaluated in terms of

catch, subject to certain allocation goals, minimizing excess returns to hatcheries, and keeping other escapements within acceptable ranges. This information is usually available to responsible teams and committees as needed both within a season and annually.

Unexpected situations and crises have been addressed by appointing interagency groups of technicians to develop ad ***hoc*** reports and recommendations. Depending on the issue, these groups existed for various periods, many becoming permanent or quasi-permanent.

Information systems often failed to meet the needs of these groups and hampered their ability to respond to problems. Existing information often had to be assembled from a number of sources before it could be used. Very often, important information was unavailable because it was not needed for normal management activities. Thus committees usually spent much of their initial effort and time creating an information base (either from existing records or by special analyses) upon which to base their evaluation and recommendations. Each new committee usually had to assemble information anew because there was no method to capture and share the work of previous groups.

Complex new issues outside routine operations, and a reliance on ad ***hoc*** groups is likely to continue and may accelerate. Petitions for listing of Snake River populations under the Endangered Species Act requires a major ongoing committment of manpower and resources from numerous agencies and organizations. Additional petitions in other parts of the basin are anticipated. It requires as much or more effort to manage small, declining populations than to manage healthy ones. Arguments and legal actions can be expected to intensify as interests contend over the best way to preserve remaining populations. Each dispute will require development and analysis of existing information and development of additional information.

Conversely, development of effective programs to rebuild salmon populations will depend upon monitoring and evaluation of a variety of actions if the region is to avoid lurching from one fad approach to another. Selective monitoring and evaluation require the intense collection and analysis of data in selected areas with extrapolation to other similar areas.

The present information systems, designed for an earlier period, are unlikely to meet the needs of a new era of intensive use of existing information coupled with both more detailed collection and use of new information. Key information exists in a variety of forms and formats, often requiring manipulation before it can be applied to system-wide questions. Each new ad ***hoc*** group must spend some time initially identifying and evaluating an appropriate information base. Staff must be reassigned to assemble information bases for each new interagency initiative. Often compromises in analyses and recommendations must be made because available information does not support application of the best available technical approach.

The challenge for responsive fishery management in the 1990's is to build upon and extend the existing information management programs to provide more comprehensive information,

faster, to a wider audience. Such a system will reduce the duplicative effort now spent in repeatedly assembling similar information for successive groups and will allow better utilization of creative group talent.

Extensions to present systems must manage three general types of information. The most familiar is probably numeric information which can be managed with traditional database techniques and is assembled, stored, disseminated, and maintained electronically. New approaches must also accommodate written information. This includes analyses and interpretations of numeric information, most often contained in various types of technical reports and articles, and the plans and programs developed to address resource management issues. Finally, ephemeral information, the results of committee actions and reports, and information never published in formal reports, for instance, must be captured, stored, and shared.

The Northwest Power Planning Council recognizes the need for and value of a coordinated system of information exchange in their Fish and Wildlife Program (Section 7.6). This project is designed to meet the needs identified in the Council's Program.

We have studied the issues involved with information sharing from four perspectives: content, acquisition, dissemination, and administration. The following material summarizes the results from more detailed investigations reported elsewhere (Weber, et al. 1992; O'Connor 1992; Allen et al. 1992; Roseberry 1992).

CIS Project History

Phase 1

Activities in Phase 1 centered on overall project design, and assembling background information on various technical issues. Much time was spent working with participants to develop an approach which would mesh smoothly with ongoing information handling programs. Results of Phase 1 activities are reported in contract reports made to the Bonneville Power Administration. They were not published as a technical report.

Phase 2

The emphasis in Phase 2 has been on developing a more detailed assessment of information needs, updating and assembling basic information on anadromous fish populations, identifying information gaps, and developing a multi-year plan for CIS testing and implementation. Products of this phase are available as technical reports and are summarized in the Preface to this report.

RESULTS AND RECOMMENDATIONS

Content

Rational decisions concerning the design and implementation of the Fish and Wildlife Program are limited by the information available about those resources. Conversely, the type of decisions which are contemplated determine the type of data collection system needed to support the program. Much of the disagreement and frustration with the program to date has arisen because of a discontinuity between available information and the type of decision contemplated. In these situations, individuals argue from bias and emotion and disputes and uncertainty increase without, necessarily, any benefit to the anadromous fish resource. Development of program monitoring and evaluation and a Coordinated Information System offer a means to reconcile decisions with the information base supporting them to produce a more effective Fish and Wildlife Program.

Elements

The Council Program calls for the CIS to include an anadromous fish data base, a habitat database, and a scientific information database (Section 7.6). Additionally, the Council describes a number of related databases to be developed by other groups and to be coordinated with the CIS. These include, for instance, information on Program expenditures (Section 7.7) and analytical tools (Section 7.3). **We** have addressed these needs in the Project Plan (Roger, et al. 1992).

Three broad components are needed to provide a useful Coordinated Information System: a set of databases of critical numeric information; a reference system containing catalogs pointing to more detailed data, available literature, current activities, and technical tools in use; and a set of central services for managing, integrating, providing access to, and generating reports from the system. These components pictured in Figure 1 and are described briefly below.

Anadromous ***Fish Information System***

Numeric information on the characteristics of anadromous salmonid populations and their habitat form the basis for our understanding of resource status and response to human

actions. The AFIS is organized on two levels. Summary databases on individual stocks (stock summary database) and stock aggregates (M&E database) will provide quick access to most of the data used by various technical groups to plan and evaluate Program actions. Information for the Annual Program Monitoring Report (Section 7.2A) will come from these databases, for instance. These summary databases are a supported by several detailed databases. The detailed databases will be combined in various ways to update the summary databases. The following data elements will likely form the core of the anadromous fish information system. Many analyses require that this data be collected in a manner such that the mean value and its variance can be calculated.

- Demographic information (of adults)
  - Abundance (catch, dam counts, escapements, etc.)
  - Age composition (numbers of fish in each age class)
  - Size (length and weight) by age
  - Number of males and females, by age
  - Female fecundity, by age and size
- Life history traits
  - Age composition of smolts
  - Timing of life history events (e.g. smolting, return, spawning)
  - Types of habitat used by each life stage
  - Ocean distribution
- Survival rates (measured by abundance at successive life stages)
  - Egg - fry
  - Fry - smolt
  - Egg - smolt
  - Downstream smolt passage
  - Survival through reservoirs, turbines, bypasses, and spillway
  - Early ocean (estuary - fishery recruitment)
  - Smolt - adult
  - Harvest rates by age and fishery
  - Prespawning
- Hatchery fish performance (in addition to the above)
  - Numbers, size, and location of releases
  - Straying of returning adults
  - Marks and/or tags used
  - Effectiveness of naturally spawning adults

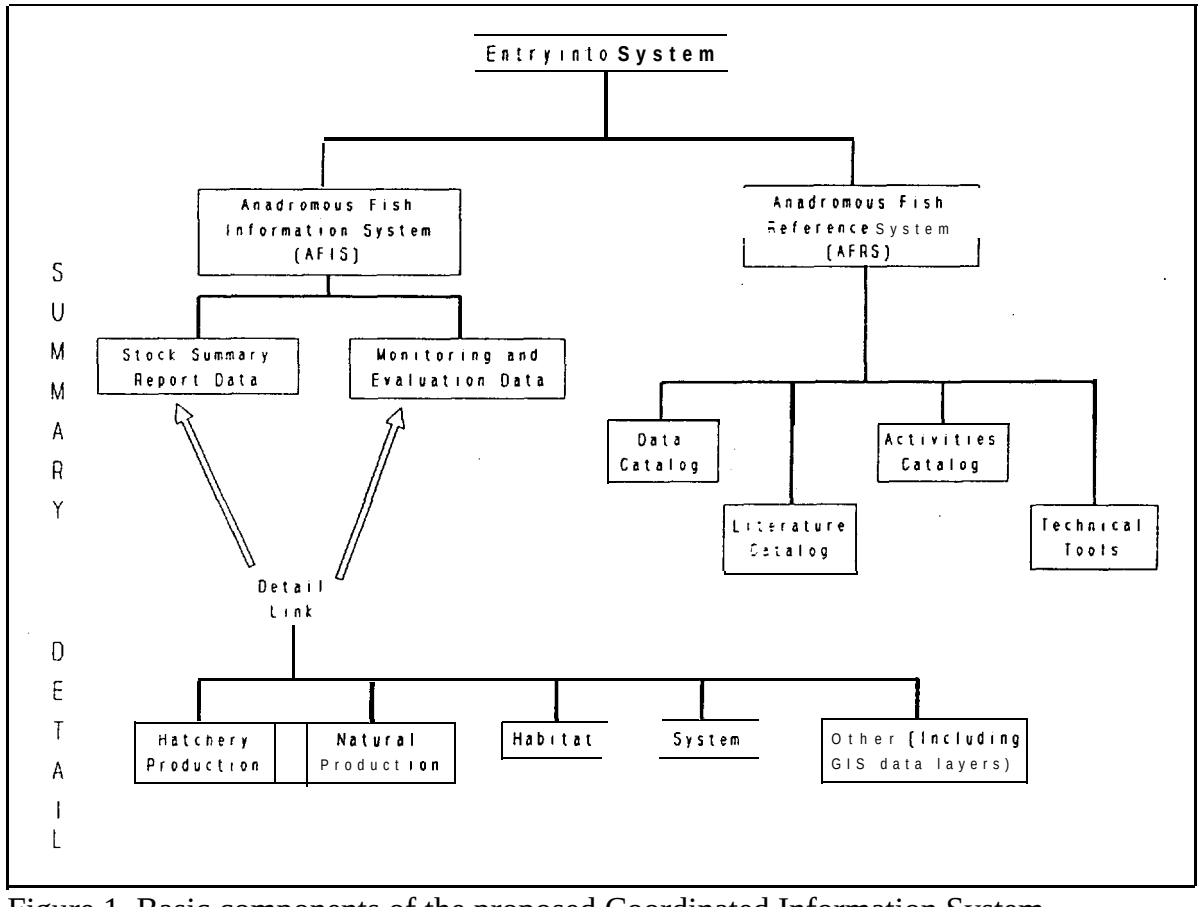


Figure 1. Basic components of the proposed Coordinated Information System.

Habitat conditions
- Present and potential smolt carrying capacity
- Limiting factors
- Cumulative effects analysis
- Riparian condition
- Effectiveness of habitat improvements
- Water rights
- Water diversions/dewatering
- Screened and unscreened diversions
- Streamflow
- Temperature
- Embeddedness
- Large woody debris
- Channel unit type

Although the value of these data is widely recognized, they are often not all available for a particular population. The degree to which these data are available will determine the appropriate level of management decision making.

Anadromous Fish Reference System

This portion of the CIS contains documentation of data items in the AFIS and may be thought of as an electronic version of the Yellow Pages in a phone book. The reference system will be composed of data, literature, activity, and tools catalogs. This system will provide documentation for data contained in the AFIS and will also describe additional information available and where and how to access it.

Central Services

This portion of the CIS will contain the user interface, reporting systems, and tools to integrate the various other layers of information. Electronic, print, and personalized methods of accessing the CIS will be provided as well as training material and periodic reevaluation of user needs. Initially, the CIS will be designed to produce various types of standardized reports. Production of user customizable reports may be added in the future. We also consider Geographic Information System technology a useful tool for integrating certain location-specific data items within the CIS and with related information in other systems, particularly the Northwest Environmental Database.

Resolution

Questions of temporal and spatial resolution of the CIS will affect its size and the uses it can serve. Initial SMEP and SSR reports will require data updates annually. Report tables have been identified at the stock (generally each subbasin), aggregated stock, and mixed stock (entire Columbia Basin) levels (NPPC 1992).

The CIS is not intended to serve as an in-season management tool. Rather it is focused at providing a breadth of information needed for planning and evaluation of the Fish and Wildlife Program over a period of time. Accordingly, the system will be updated and refined on an annual cycle, rather than over shorter periods of time appropriate for in-season use. This will reduce duplication of existing information services and the reporting burden on data producers.

Aggregation will generally increase from the data collection level, through agency summaries, to the regional CIS, although efficiency may dictate that portions of the CIS contain very detailed data elements. That is, reports from data collectors to state coordinators will be summaries of all the information taken in the field. Likewise, reports from state coordinators to the regional CIS system may be further summarized. The system will be constructed and documented in such a way that users are aware of the degree of aggregation existing at each layer and how to access more detailed information.

Integration

Internal Integration

The issues of internal integration include user interface, coding standards, and overlap between modules. Ease of use is an important component of a usable and useful data sharing system. If a consistent appearance and menu structure is adopted for both AFIS and AFRS, users can take advantage of previous learning to hasten their familiarity with the system they use less often. Common coding standards improve the ability of the CIS programmers to make future changes to the code. Regular communication between individuals working on the AFIS and AFRS systems (whose development will proceed simultaneously) will ensure that' the coding standards we adopt during prototyping are followed throughout development subject to system content and user needs

Overlap between system modules due to similarity in content will be relatively common, due to the incremental approach we will take to building the CIS. Not all of the CIS information modules need to be developed at the same speed; the CIS will grow in steps to meet user needs. Each of these modules could/would have varying degrees of complexity, various data contained within them, pointers to other data sources, interrelation with other modules, and possibly different methods for accessing and retrieving information. As the system is developed, the overlap between modules will become apparent and will be addressed through

a database optimization process.

External Integration

The main concern related to external integration of the CIS is our need to collaborate with other regional data sharing efforts to ensure compatibility of formats and approach. The region cannot afford to waste its talent and resources on developing systems that duplicate existing capabilities. We will work to prevent this by involving fisheries workers who participate in all of the major systems modelling and evaluation efforts (to keep the CIS Steering Committee informed of similar efforts). We will employ linking codes to such existing systems as the Northwest Environmental Database and develop linking mechanisms to other databases and resource collections as appropriate.

Acquisition

At present, assembling major sets of information is a daunting task. Recent activities along this line (Howell 1985; subbasin planning; the present Stock Summary Reports) have required months to complete and have not been maintained regularly because of the enormous resources and effort required. Efficient collection and organization of information need not be such an onerous task and is absolutely vital to promote program effectiveness. Efficient information processing will require changes in present practices, however. These can only be implemented in an evolutionary process because of the diversity and complexity of the issues involved. Initially, we have identified a few standard practices necessary to develop the initial CIS and begin a process of improving information management.

Standards

A core concept of the CIS is to link both numeric and written information into a system from which a user can easily and quickly identify what is available in the system (plus pointers to other data) and retrieve what is needed. To accomplish this requires that minimal standards be applied to all types of information to facilitate integration. At a minimum, all information should meet coordinated reporting schedules, contain certain common information to allow cross referencing, and be submitted in easily incorporated formats.

Specifically, elements within the database portion of the CIS must identify the methods used to generate the entry (e.g. direct observation or a particular analysis), sampling procedures used, if any, and the EPA code locating where the data were obtained (where possible). This EPA code will also be applied to the contents of the data catalog and literature catalog, as appropriate. Thus the data entries will be internally documented.

CIS data elements will usually be updated once a year. However, the schedule for accomplishing this will vary by data type. Field data are usually processed at the end of

each season. The CIS will work with data providers to develop methods and procedures to produce all needed CIS information at this time. Thus field personnel will not need to reanalyze or process data a second time to generate CIS reports.

Recommended Changes

Presently, a basin-wide compilation of even basic fishery information is a major undertaking involving reallocation of staff time, months of effort combing through various paper and electronic files, and hundreds of thousands of dollars. This need not be the case for core CIS data, although new methods and procedures will need to be developed and implemented. This can be accomplished gradually as opportunities present themselves.

New information processing methods should be adopted wherever feasible. These include, but may not be limited to, the following:

- The CIS should serve the basin as the primary method of exchanging anadromous salmonid information between agencies and groups.
- Agencies should cooperate to standardize procedures wherever appropriate. For instance, field procedures and error checking procedures might be agreed upon for certain commonly collected information. Variations could be described to accommodate field logistics and particular agency needs.
- Agencies should develop data handling procedures that are "single pass". For instance, error checking follows data entry; storage follows error checking; analysis follows storage; reporting follows analysis. In this sequence, information could flow easily to the CIS.
- Data entry programs should include validation and correction routines to reduce the possibility of errors.
- Data should be stored in electronic form as early in the process as possible, ideally in the field as measurements are taken.
- Technical reports should contain an abstract and keywords assigned by the author(s).
- Technical reports should be stored in electronic as well as printed form.

Information Gaps

Much of the information needed for monitoring and evaluation and SSR's is unavailable in

standard formats. For instance, approximately eighty percent of the information requested for the standard SSR tables does not exist in the form desired. Sometimes this information has not been collected for a particular population. In other cases, relevant information may exist, but require a degree of analysis to transform it into standard format.

Unavailable information severely limits evaluation and planning decisions and poses a challenge to the region for filling information gaps. The CIS can identify these gaps and assist in designing new information handling procedures. We cannot, however, decide which information is most important to the region or where monitoring is most important. These decisions require a degree of data analysis and have policy impacts. The CIS forum is inappropriate for these purposes.

Resource managers should explicitly decide the level and type of management actions appropriate to the Fish and Wildlife Program. Technical committees could then design a monitoring program appropriate to support the decision process. The CIS project can support, but not design, this system by developing and encouraging greater standardization and efficiency in information handling and reporting procedures. In addition, the CIS Steering Committee can contribute to this process by recommending appropriate protocols and technology to meet stated needs for information content and delivery schedules.

Dissemination

Dissemination of information has been on an ad ***hoc*** basis in the past. Distribution lists exist for some types of written reports. However, these are updated infrequently and primarily as a result of individual requests. It is unusual for key data items to be easily available beyond those people immediately involved in their collection or analysis. Researchers and planners wishing to explore new hypotheses or strategies often must first spend considerable time learning from other individuals what information is available in particular areas, then additional time determining whether that information is useful in exploring the original question. The CIS will provide an efficient place for people to identify and access the existing knowledge base for anadromous salmonids in the Columbia Basin.

Performance

Users have repeatedly stressed the need for ease of use, accessibility, and speed in describing system performance. Different users probably have different ideas about what these terms mean, however. The Steering Committee might initially define them as meaning a system which requires less than half a day to learn, is available through a desktop PC and-delivers results at 9600 baud or faster (if a phone connection is involved) for data and within seven working days for documents or other material. Actual performance criteria will be developed during system development through interaction and feedback from user groups.

Methods

Differing user needs and the logistics of different information sets require that a variety of dissemination methods and techniques be evaluated. The CIS will be primarily a PC based system. Certainly activities such as searching the data and literature catalogs, and extracting custom data sets will be almost exclusively computer activities. Other actions such as distributing standardized reports and documents may be done via computer files or had copies, however. We anticipate that some users will need assistance in training or developing custom uses of the system, in which case direct personal interaction will be required.

Computer access methods, standard reporting procedures, and those personal interactions identified by user groups as necessary will be defined during system development.

Administration

Final decisions on a CIS administrative structure are not necessary until the end of Phase 3 activities. During Phase 3 prototype testing, operating principles, structure, and cost will be evaluated and final recommendations will be made to policy makers.

Principles

The CIS is intended to be an open system providing consistent quality information in response to user expressed needs. We feel the following principles will further this goal.

- CIS will provide a network among Columbia Basin information producers and information users to support communication, sharing, and dissemination of anadromous fish information while minimizing duplication of effort.
- CIS will coordinate with existing information management programs and will minimize duplication with these efforts.
- Information producers will supply updates on regular jointly developed schedules and in consistent formats appropriate for the various types of information.
- The CIS will be developed to meet identified user needs in terms of content, interface, and information delivery. Needs will be periodically reevaluated and the system modified as appropriate.
- Speed, accuracy, and reliability will be emphasized.
- The CIS shall not discriminate between users of the system.
- Copyright law may apply to some information. If this occurs, CIS will follow the provisions of the Fair Use portion of the Copyright Act.
- The CIS shall not include information normally considered confidential.
- Data shall be exchanged using jointly developed standards and procedures to insure

information quality, consistency, and timeliness.

- Data shall conform to jointly developed documentation standards. Documentation shall include data methodology, and references as appropriate.
- National standards (e.g. Library of Congress, machine readable cataloguing codes, etc.) shall be used for organizing written material to promote sharing with other regional and national sources.
- The EPA river reach coding system will be used as a location code and cross reference between elements of the CIS as appropriate. This coding system will be promoted as part of critical links to other systems.
- Material meeting the above standards shall not be discriminated against.

Structure

Structural Design

Four options for the structural design of the CIS (Table 1) were evaluated in the Technical and Administrative Options Report (Allen et.al. 1992). Of the four options, the CIS Steering Committee has agreed the "Distributed-Connected" option best meets the identified needs of potential CIS users. Although this may change once prototyping is completed, the flexibility of this option would meet nearly all identifiable access methods users would require. While the following discussion describes a computer system, we will also evaluate the need for other delivery methods and will provide a level of personal service.

The distributed-connected structural design (Figure 2) allows for diskette distribution to users, plus the option of connecting a user's computer to a central computer. The connection would allow for the immediate download of all (or selected) updated information and data files. Also, upgrades to the system could be performed directly. The central computer would run either a commercially available "Bulletin Board System" (BBS) software program, or a proprietary program designed specifically for the CIS. A BBS program and a proprietary program differ in the amount of user interaction allowed. A BBS has minimal user interaction whereas a proprietary program can be designed to be as user-friendly as possible.

The distributed-connected structural design is not limited to an either/or system as various hybrids of a BBS-proprietary program could be designed. An example would be a program written to step a user through a BBS. Another option is to develop a system in 'incremental steps beginning with a basic BBS and evolving into a proprietary program operating alone or in conjunction with a BBS.

Distribution of the system would initially take place via diskettes. However, all subsequent updates and upgrades could take place via modem. Users without access to a modem would still have their system updated via diskette.

The distributed-connected design has the benefits of a user-friendly look-up program as well as the advantages of access to a central computer for direct updates. It allows the users to determine which method (modem or direct mailing) they wish to use to access or update data. This design is more complex than the other options described in the Technical and Administrative Options Report (Allen, et al. 1992). The final determination of 'the structural design and fine-tuning of that design will be made after CIS Phase 3 prototyping.

Table 1. Structural design options for a Coordinated Information System (Y=yes; N=no; 0 =optional) .

ELEMENT	STRUCTURAL DESIGN[1]				
	PRESENT SYSTEM	BBS[2]	DIST.[3] S.A.	DIST.[4] CONN.	CENTRALIZED
Personal computer	O	O	Y	Y	O
Dumb Terminal	O	O	N	Y	Y
Term. Emulation Software	O	O	N	N	Y
Modem	O	Y	N	Y	Y
Diskette distribution	N	N	Y	Y	N
Bulletin board	N	Y	N	Y	N
User Interactive	N	N	Y	Y	Y

[1] See Allen, et al. (1992) for full descriptions
[2] Bulletin board system
[3] Distributed, stand alone system
[4] Distributed, connected system

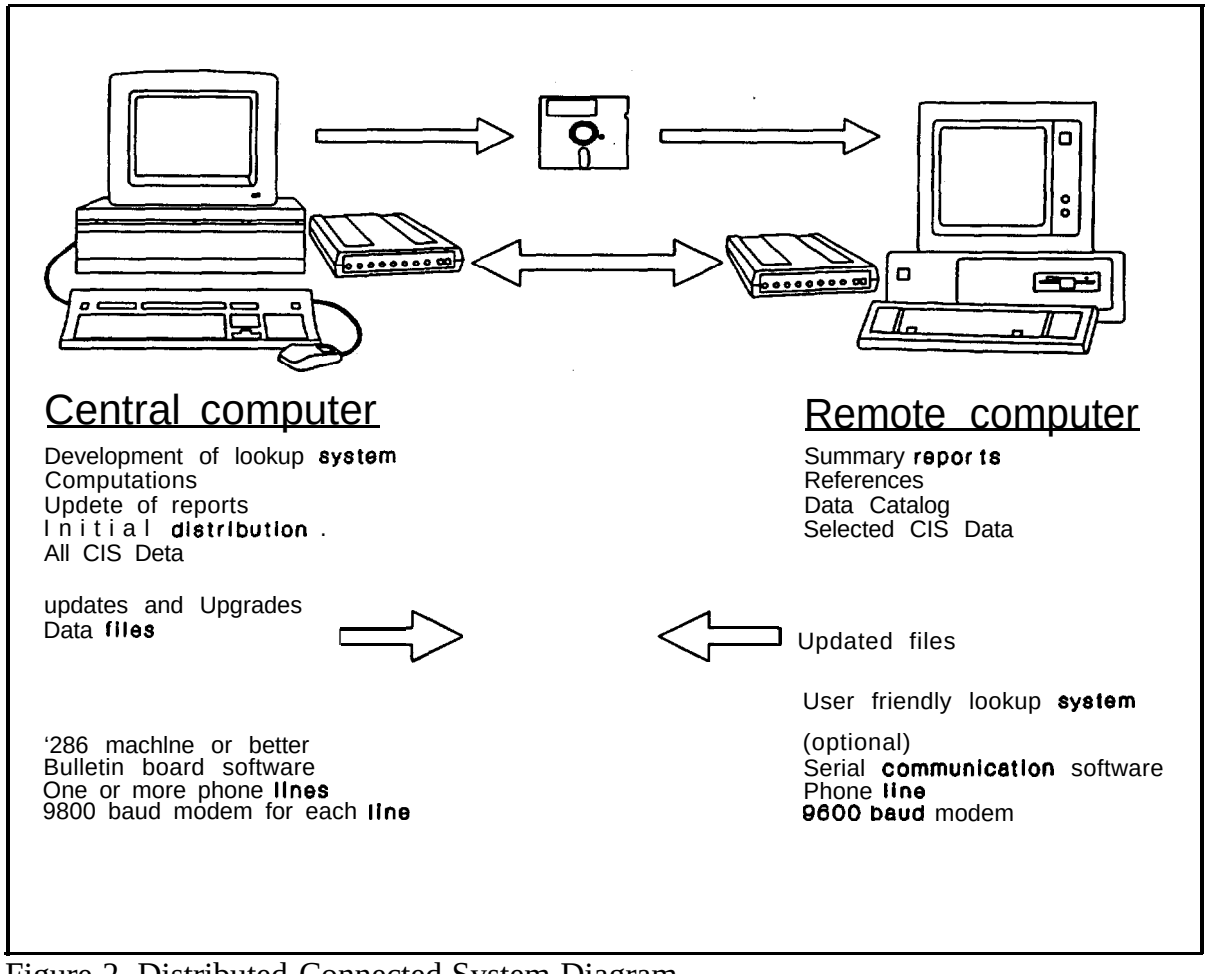


Figure 2. Distributed-Connected System Diagram

Administrative Structure

"Administrative structure" describes the individuals and geographic location of those people who will support the CIS system and CIS users. Four options (Table 2) were evaluated in the "Technical and Administrative Options Report" for determining the administrative structure of the CIS. The CIS Steering Committee has recommended the "Centralized/Distributed" administration option as the one which best serves the needs of all potential CIS users and the long-term needs for system maintenance and data coordination.

The centralized/distributed administration would be minimally comprised of a central data coordinator and support staff necessary for routine maintenance and report generation, along with a data coordinator for each state (Figure 3). These positions would be dedicated to CIS activities. The state coordinators would respond to data requests, provide updates, and distribute CIS products to end users within their state. They would be responsible only for data requests that concern their state. The central coordinator would organize the efforts of state coordinators and provide CIS services to regional end users (e.g. those who are working with "system" or regional data, e.g. mainstem flow information or ocean harvest). The current administrative structure of the Northwest Environmental Database is an example of this form. It has proven to be a solid and workable approach to standardized regional data collection and sharing.

Given that a strong coordination effort is emphasized, a benefit of this structure is that the states would be committed to support the CIS. Data collection duties would be 'handled by the state coordinators, which would alleviate the need for the central coordinator to deal directly with the field level data collectors. This option also personalizes the interaction between CIS staff and data users/providers at a local level. A drawback to a centralized/distributed structure is the possibility of individual states digressing from the primary CIS direction. This could occur if coordination was not emphasized.

In the meantime, policy representatives of state, tribal, and federal fishery agencies, with the Bonneville Power Administration, developed the following principles in a meeting on September 21, 1992, to guide operation of the CIS.

- CIS is needed to provide an efficient system of data compilation and distribution concerning anadromous fish resources in the Columbia Basin. It will be technically based and not be policy reactive.

- The project will be managed by PSMFC (third party).

- Conditions of project management requested by PSMFC.

    - There will be a single funding instrument with PSMFC.
    - The project manager will be housed in PSMFC.
    - The project manager will chair the Core Group.

- The Core Group (Steering Committee) already in place and functioning will continue as the technical advisors to define need projects and work plans. PSMFC will have the project manager chair this function.

- The final budget will be established based on the Core Group's development of work plan.

- The Policy Review Group (PRG) in the Implementation Planning Process (IPP) will be used for policy guidance to the extent such issues arise.

- The Scientific Review Group (SRG) within IPP is already established and is the appropriate body for technical review on direction from the PRG.

System Maintenance, Updates, and Enhancements

We have defined work products in the Project Plan (Roger, et al. 1992) that address the process of maintaining and updating the contents (detailed data, summary data, reference information) of the CIS components. System maintenance actually begins during the development process, as development team members test and evaluate the prototypes as they emerge. The close relationship between programmers and users serving on the development team will evolve into a formal feedback loop after implementation of the CIS. This capability for users to access those responsible for development of the system code will help resolve problems found in the workings of system components and reveal useful enhancements.

If our users become as involved with the CIS as we believe they will, there will likely be a long list of proposed updates and enhancements to the system. We will manage these by prioritizing such requests on the basis of the number of users requesting a specific improvement, the frequency of use of that capability, the availability and cost of any additional data that might be needed, and whether or not a system already exists in the region that can meet the expressed need.

Table 2. Administrative design options for a Coordinated Information System and elements of the designs (N = no one has responsibility, C = central Steering Committee responsibility, S = individual state responsibility, B = both central and state responsibility).

ELEMENT	ADMINISTRATIVE DESIGN OPTIONS[1]				
	PRESENT SYSTEM	CENTRAL	CENT/DIST #1	CENT/DIST #2	DISTRIBUTED
CIS administration	N	C	B	B	S
Coordination	N	C	B	B	S
Promo/represnt	N	C	C	B	S
Maintenance	S	C	C	B	S
Regional use	S	C	C	C	S
State use	S	C	C	S	S
Regional update	N	C	B	B	S
State Update	S	C	S	S	S
Library Functions	N	C	C	B	S

[1] See Allen, et al. (1992) for full descriptions

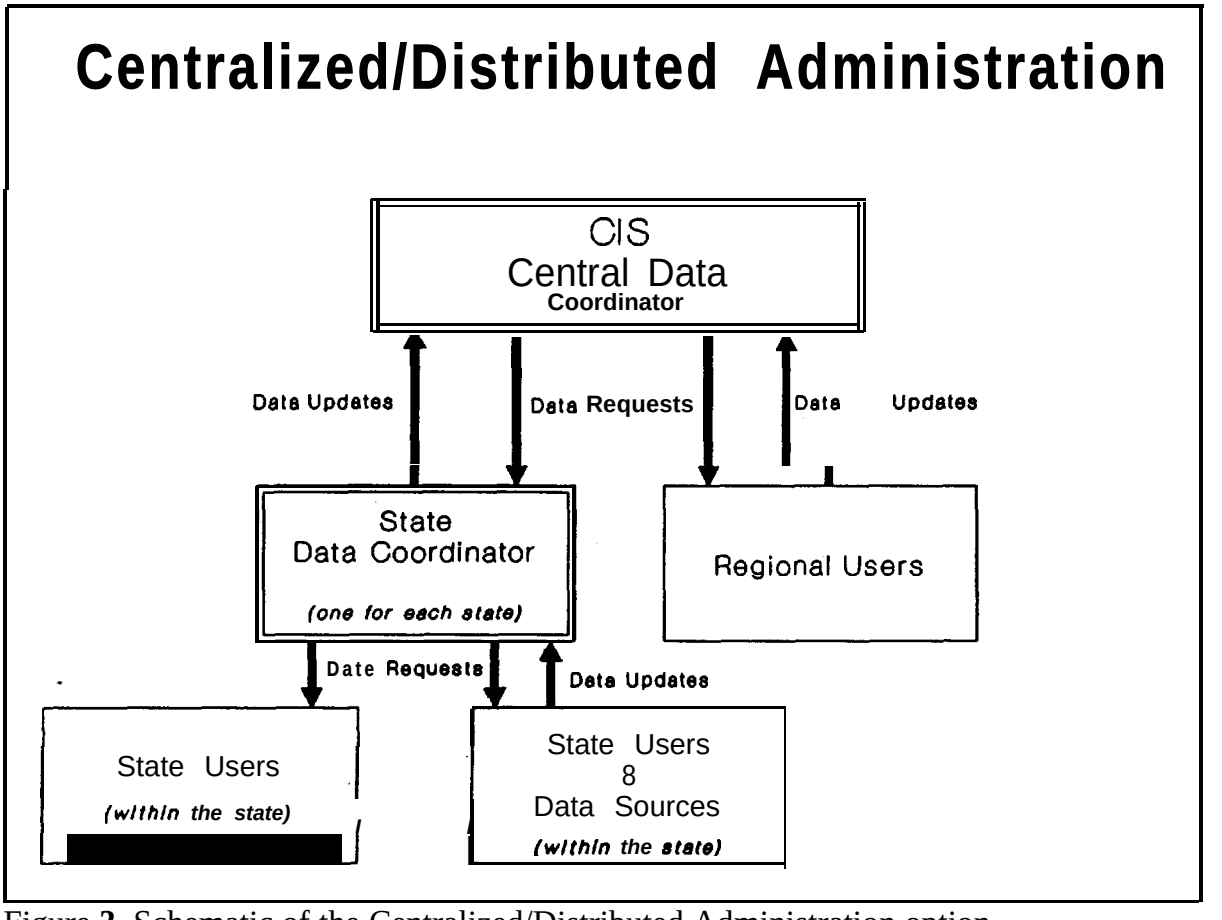


Figure **3.** Schematic of the Centralized/Distributed Administration option

Cost

The value of a fully operational CIS is difficult to quantify but would be substantial. Some of the heaviest users of a CIS are expected to be various modelling groups and regional planning efforts. Modelling projects usually do not separately estimate the costs of data collection and standardization. Every modelling effort does include data gathering activities, however, and the CIS would certainly simplify these tasks and reduce costs. The greatest difficulty encountered by regional planners is often assembling a commonly agreed upon set of information which adequately describes the issues under consideration. Assembling this information is crucial to resolution of issues as diverse as developing harvest controls (Pacific Salmon Treaty negotiations), restoring and balancing production (subbasin planning), or preserving critical populations (ESA petitions and recovery plans). Information proposed for inclusion in the CIS is valuable to all these activities. The dollar value of a coordinated and standardized information base for these activities is impossible to estimate. However, even a small improvement in efficiency would have a high dollar value, because of the very high cost of such activities.

Another perspective might be gained from looking at the cost and potential benefits of the CIS relative to the overall Fish and Wildlife Program. Annual costs of developing, maintaining, and enhancing the CIS are expected to be between $1 .O million and $1.3 million annually (Table 3). This cost would be more than repaid by only a very modest reduction in cost or improvement in productivity for other projects. For instance, if the CIS resulted in only a five percent cost savings or productivity improvement to 25% of the Program (assuming a total Program cost of $100 million, the dollar value would be roughly $1.25 million.

Conversely, certain indirect costs are also associated with not developing a Coordinated Information System. Although these. costs cannot be estimated easily, they. should at least be recognized when decisions concerning the CIS project are made.

These indirect costs are of two general types: costs resulting from duplicative development of information and costs resulting from lower program effectiveness. The typical approach to dealing with issues in fishery resource management is to form a technical team to develop options and recommendations for a policy body to decide. Each important issue usually has its own technical group composed of members who may or may not have dealt with similar issues before. The group must first develop and agree on the basic technical information upon which options and recommendations will be based. **Many** times groups spend considerable time simply accessing and organizing information for their particular needs. Often, a group will develop a set of core information similar to one used by a previous group. The CIS could reduce the duplication of time and costs associated with this traditional approach to dealing with fishery issues.

Another set of indirect costs are incurred when the mix of program actions are less efficient than necessary because information is unavailable to identify effective and ineffective

strategies. In this situation it takes longer than necessary to adopt effective strategies. In the meantime, funding continues for less effective actions.

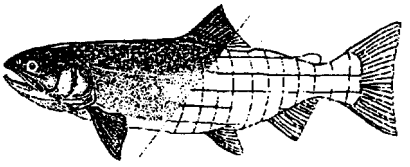


TABLE 3. Summary of projected total CIS budget through testing and implementation.

	PHASE 3		IMPLEMENTATION
AGENCY	YEAR1	YEAR2	YEAR3
Proj . Mngr.	106,407	100,910	106,339
CRITFC	181,034	184,217	196,866
IDFG	248,292	350,294	214,474
ODFW	129,276	197,422	204,984
SHO-BAN	36,012	30,671	21,469
USFWS	30,569	34,464	35,414
WDF	176,918	249,734	188,870
WDW	111,571	113,078	116.240
SUB TOTAL	1,020,079	1,260,789	1,084,655
PSMFC	20,402	23,198	19,566
TOTAL	1,040,480	1,283,986	1,104,222

GLOSSARY

AFIS - Anadromous Fish Information System. That part of the CIS which contains numeric information about Columbia Basin salmon and steelhead populations and their habitat.

AFRS - Anadromous Fish Reference System. That portion of the CIS which contains non-numeric information about Columbia Basin fish populations and efforts to restore them.

Agency Data Collectors - Each agency represented on the Steering Committee for Phase 3 has dedicated staff funded to collect and provide data.

Basin - That portion of the Columbia River Basin accessible to anadromous fish, unless indicated otherwise by the context.

BBS - A computer bulletin board system. These systems are becoming more. common in the Columbia Basin as a methods of communication and document exchange between widely dispersed individuals.

BPA - Bonneville Power Administration

CBFWA - Columbia Basin Fish and Wildlife Authority. A cooperative coordinating body composed of state, federal and tribal fish and wildlife management entities.

CIS - Coordinated Information System. This project.

CIS Core Group -A group containing a single technical representative from each of the following entities: Columbia River Inter-Tribal Fish Commission, Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife, Shoshone-Bannock Tribes, U.S. Fish and Wildlife Service, Washington Department of Fisheries, and Washington Department of Wildlife. The Core Group was charged with directing the technical activities of the CIS project through Phase 2. See Steering Committee, below.

CIS Work Group - The CIS Steering Committee plus other staff assigned duties under the CIS project.

Council - The Northwest Power Planning Council, unless indicated otherwise by the context.

Data - numbers, especially measurements, counts, and estimates pertaining to various aspects of anadromous fish populations and habitats.

Development Team - A group composed of the Steering Committee, the Programming Team, and 5-10 representative regional data users who will test prototype products developed during Phase 3.

EPA - Environmental Protection Agency

ESA - Endangered Species Act.

IHOT - Integrated Hatchery Operations Team. Representatives of fish management entities charged with developing more comprehensive and consistent operational guidelines for anadromous fish hatcheries in the Columbia Basin.

Information - This term is used in various senses. Most often it is used to distinguish numeric from non-numeric information about fish populations. Sometimes, however, references are made to numeric information or to information as data which has been interpreted to reach a non-numeric conclusion.

Iterative Programming - The process of creating software modules, reviewing the modules with users, and subsequently modifying the software based on direct user feedback. Usually several repetitions of this process are used to reach the most useful solution.

Librarian - A Librarian retained for CIS.

NED - Northwest Environmental Database.

NPPC - The Northwest Power Planning Council.

PMIS - Project Management Information System, an internal BPA project designed to collate, summarize, and deliver up-to-date information related to BPA-funded projects.

Project Manager - An individual hired during Phase 3 to work closely with the Steering Committee to implement the CIS Statement of Work and coordinate efforts with other similar regional projects.

Program - The NPPC Fish and Wildlife Program.

Programming Team - A group composed of a full-time Lead Systems Analyst, a part-time Consulting Systems Analyst, and two full-time programmers.

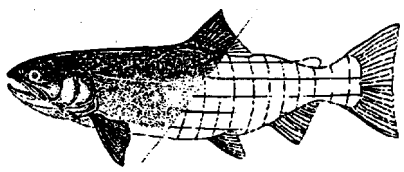
Rapid Prototyping Technique - A process which relies on iterative interaction between software developers and users to quickly generate desired products starting from an initial list of requirements.

Reference - Text or other non-numeric information (e.g. maps) as distinct from numeric information. Often reference information provides documentation for associated numeric information.

SSR - Stock Summary Report.

Steering Committee - The name applied to the former Core Group for Phase 3 activities and beyond. Membership and responsibilities remain as described for the Core Group (see above). A group composed of one member each from Columbia River InterTribal Fish Commission (CRITFC), Oregon Department of Fish and Wildlife (ODFW), Idaho Department of Fish and Game (IDFG), the Shoshone-Bannock Tribes (Sho-Ban), U. S. Fish and Wildlife Service (USFWS), Washington Department of Wildlife (WDW), Washington Department of Fisheries (WDF), and a Project Manager.

Stock - As used in the Stock Summary Reports, this term designatesa particular production type (hatchery or natural) in a particular geographic area. No presumption is necessarily made about the genetic relationships between these stocks or about their evolutionary significance.



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Appendix A: Map to Phase II contract deliverables

OBJECTIVE 1 - Coordinated Information System

Task 1. Coordinate CIS Activities

Work Plan and Schedule -

Schedules have been set for the development and completion of various products.. These are available either in quarterly project reports, modifications of the cooperative agreement, or in project files. These are not included in any of the technical reports submitted in completion of Phase 2 activities.

Scope of Work -

The primary description of the Phase 2 scope of work is included in the cooperative agreement between BPA and the PSMFC. Additional detail is given in individual subcontracts, project modifications, and project files. Details are not included in technical reports submitted as part of the Phase 2 activities.

Report on Principles and Procedures -

CIS principles and procedures are incorporated in Roseberry (1992), in Allen, et al. (1992), and Roger, et al. (1992), submitted in partial fulfillment of Phase 2 deliverables.

Task 2. Identify information needed to plan, monitor, and evaluate actions pursuant to the Fiih and Wildlife Program with particular emphasis on SMEP.

List of Users -

See Weber, et al. (1992).

User Questionnaire -

See Weber, et al. (1992).

List of Data Elements needed for SMEP -

The System Monitoring and Evaluation Program has not been completed by the NPPC. For a list of those SMEP data needs which have been tentatively identified, see Weber, et al. (1992) and Roger (1992).

Analysis Methods used by SMEP -

SMEP analysis methods are only incompletely identified to date. Normal statistical procedures (sums, means, variances, etc.) will be used to produce those SMEP elements which must be estimated from detailed data sets.

Task 3. Based on the results of the report completed in Phase I, develop methods for integrating habitat classification into the System Monitoring and Evaluation analysis to improve estimates of fiih carrying capacity.

Final Analysis Report -

This deliverable was to incorporate the other two deliverables under this task. See the descriptions below.

Workable Model -

Work on watershed modelling was suspended during Phase 2 due to disagreement about what constitutes a "workable model". Since data collection was not part of Phase 2 activities, it was impossible to develop an operating computer model.

List of Classification Variables -

See Weber, et al. (1992) for those variables which have been identified as most useful for a variety of habitat classification methods.

Task 4. Describe existing sources of information needed to plan, monitor, and evaluate actions pursuant to the Fish and Wildlife Program, with particular emphasis on SMEP.

A comprehensive data catalog integrated with those prepared under Objectives 2, 3, and 5 -

A Data Catalog comprised of a data set directory and a data item directory

was produced as required (O'Connor et al. 1992).

Task 5. Prepare initial options and recommendations for data sharing, missing data elements, hardware/software capabilities and operational issues for administrative review by implementing agencies.

A report describing technically feasible options for data sharing, missing data elements, hardware/software capabilities, and operational issues for review by CBFWA members, NWPPC, and BPA.

A report describing options for technical and administrative issues was developed (Allen, et al. 1992). That report has been discussed with the CBFWA Liaison Group, individually and as a group. The Liaison group supports the recommendations of the Allen report and the Phase 3 activities as described in the Project Plan (Roger, et al. 1992).

Missing data elements are identified in the Information Needs Report (Weber, et al. 1992). During development of that report, it became apparent that recommendations about how to fill data gaps was inappropriate to this project, since they largely involve policy considerations regarding decision making and contracting details. This project addresses technical aspects of information sharing and cannot resolve these questions.

Task 6. Analyze and prepare a Project Plan for the remainder of the project.

A project plan explaining the project's duration and staff requirements, and that provides a cost-benefit analysis at a level of detail sufficient to enable policy makers to make an informed decision on the utility of the project.

A Project Plan for Phase 3 was developed (Roger, et al. 1992) and has been reviewed by the CBFWA and NPPC staff. We have received no negative comments from those groups and they have stated their support for continuation of the CIS into Phase 3.

OBJECTIVES 2 AND 3
NATURAL PRODUCTION DATABASE
HATCHERY PRODUCTION DATABASE

The tasks and deliverables described under Objectives 2 and 3 are similar except that Objective 2 addressed the Natural Production Database (NPDB) and objective 3 addressed the Hatchery Production Database (HPDB). Results for both activities are described under the tasks below.

Task 1. Identify SMEP and others' needs for natural (hatchery) production information, the data elements needed to produce that information, and the anticipated schedules for SMEP reports.

A list of users -

See Weber, et al. (1992).

User questionnaire -

See Weber, et al. (1992).

An enhanced, detailed list of elements needed for SMEP -

The System Monitoring and Evaluation Program has not been completed by the NPPC. For a list of those SMEP data needs which have been tentatively identified, see Weber, et al. (1992) and Roger, et al. (1992).

An outline of analysis methods for SMEP related to NPDB (HPDB) -

SMEP analysis methods are only incompletely identified to date. Normal statistical procedures (sums, means, variances, etc.) will be used to produce those SMEP elements which must be estimated from detailed data sets.

Task 2. Produce a data dictionary of available data elements identified in Task 1, including whether they are currently available, present methods of collection and storage, and accessibility.

A data dictionary -

A data dictionary has been incorporated into the Data Catalog described under

Objective 1 (O'Connor et al. 1992).

Task 3. Determine data gaps.

A list of information which does not presently exist -

See Weber, et al. (1992).

Task 4. Identify options for accessing natural (hatchery) production databases in a timely manner to meet SMEP reporting schedules.

A draft report for administrative review that analyzes options for accessing natural (hatchery) production databases, identifies existing data sharing systems, and analyzes the technical feasibility of building on existing systems vs. establishing a new system.

SMEP reporting schedules have not been identified by the NPPC. Annual updates of material in the Stock Summary Reports is being designed into the CIS. Much of these data will probably be appropriate for SMEP use when that program is designed.

Existing hatchery databases are described in the Data Catalog (O'Connor et al. 1992). CIS databases will be developed as a subset of and work cooperatively with existing agency databases. The CIS will provide easier access to production data and relieve agencies of responding to repetitive user requests for information.

OBJECTIVE 4
STOCK ASSESSMENT

Task 1. Compile information from subbasin planners on stock characteristics. Develop the information by geographic units similar to System/Subbasin Planning.

Summarized information by stock within geographic unit -

See Olsen, et al. (1992), Hymer, et al. (1992) and Kiefer, et al. (1992).

Task 2. Develop reporting format for the above information and procedures for efficiently updating this information periodically. The formats and procedures will be integrated with the CIS and SMEP.

A set of procedures, including data input/retrieval, for future updating and for practical use -

Information assembled for the Stock Summary Reports was found in numerous formats and often required additional analyses and/or organization to fit standard formats. Consequently, a great deal of time and individual judgement was needed. This precluded automating the data acquisition and storage process. These issues will receive more attention in Phase 3. The SSR summary databases will be updated annually in the meantime, however.

Task 3. Complete a final updated version of the 1985 Stock Assessment Report using all information from that report and from Task 1.

Updated versions of the 1985 Stock Assessment Report. All data will be stored and presented in flat ASCII electronic format.

See Olsen, et al. (1992), Hymer, et al. (1992) and Kiefer, et al. (1992).

OBJECTIVE 5
HABITAT AND LAND USE DATABASE

Task 1. Produce a data dictionary of available classification variables identified in Objective 1, task 3 (watershed methodology) and which are not included in Objective 2, Task 2, including present methods of collection, storage and accessibility.

A data dictionary -

See Weber, et al. (1992) for important habitat variables and O'Connor et al. (1992) for a description of datasets and individuals who maintain that information.

Task 2. Determine data gaps.

A data list of information which does not presently exist -

See Weber, et al. (1992).

A report which describes existing databases -

See O'Connor, et al. (1992).

Options for filling data gaps -

A report describing options for technical and administrative issues was developed (Allen, et al. 1992). That report has been discussed with the CBFWA Liaison Group, individually and as a group. The Liaison group supports the recommendations of the Allen report and the Phase 3 activities as described in the Project Plan (Roger, et al. 1992).

Missing data elements are identified in the Information Needs Report (Weber, et al. 1992). During development of that report, it became apparent that recommendations about how to fill data gaps was inappropriate to this project, since they largely involve policy considerations regarding decision making and contracting details. This project addresses technical aspects of information sharing and cannot resolve these questions.

Task 3. Identify options for accessing available habitat and land use data in a timely manner to meet SMEP reporting schedules.

A draft report for administrative review identifying existing data sharing systems and analyzing the technical feasibility of building on existing systems vs. establishing a new system.

SMEP reporting schedules have not been identified by the NPPC. Annual updates of habitat material in the Stock Summary Reports is -being designed into the CIS. These data will probably be appropriate for SMEP use when that program is designed.

Existing databases are described in the Data Catalog (O'Connor 1992). CIS databases will be developed as a subset of and work cooperatively with existing agency databases. The CIS will provide easier access to important habitat data and relieve agencies of responding to repetitive user requests for information.